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## XVII. Science and Technology/Engineering, Grade 8

## Grade 8 Science and Technology/Engineering Test

The spring 2007 grade 8 MCAS Science and Technology/Engineering test was based on learning standards in the Massachusetts *Science and Technology/Engineering Curriculum Framework* (2006). The *Framework* identifies four major content strands listed below. Page numbers for the grades 6–8 learning standards appear in parentheses.

- Earth and Space Science (*Framework*, pages 32–33)
- Life Science (Biology) (*Framework*, pages 51–53)
- Physical Sciences (Chemistry and Physics) (*Framework*, pages 67–68)
- Technology/Engineering (*Framework*, pages 87–89)

The *Science and Technology/Engineering Curriculum Framework* is available on the Department Web site at [www.doe.mass.edu/frameworks/current.html](http://www.doe.mass.edu/frameworks/current.html).

In *Test Item Analysis Reports* and on the Subject Area Subscore pages of the MCAS *School Reports* and *District Reports*, Science and Technology/Engineering test results are reported under four MCAS reporting categories, which are identical to the four *Curriculum Framework* content strands listed above.

### Test Sessions

The MCAS grade 8 Science and Technology/Engineering test included two separate test sessions. Each session included multiple-choice and open-response questions.

### Reference Materials and Tools

The use of bilingual word-to-word dictionaries was allowed for current and former limited English proficient students only, during both Science and Technology/Engineering test sessions. No other reference tools or materials were allowed.

### Cross-Reference Information

The table at the conclusion of this chapter indicates each item's reporting category and the *Framework* learning standard it assesses. The correct answers for multiple-choice questions are also displayed in the table.

# Science and Technology/Engineering

## SESSION 1

### DIRECTIONS

This session contains seventeen multiple-choice questions and two open-response questions. Mark your answers to these questions in the spaces provided in your Student Answer Booklet.

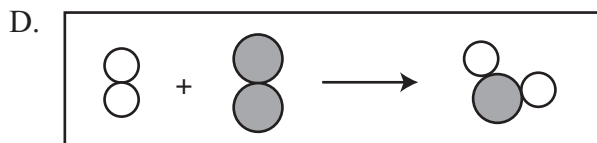
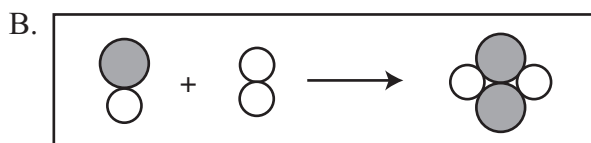
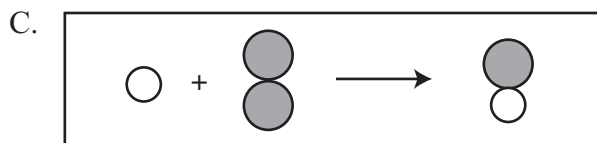
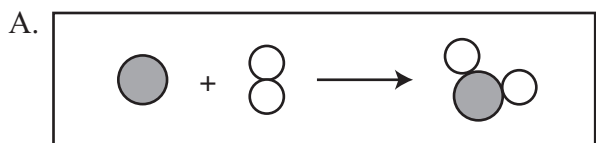
1 Which of the following keeps the planets in our solar system in orbit around the Sun?

- A. atmospheric pressure
- B. gravitational force
- C. electromagnetic energy
- D. thermal energy

2 Which of the following groups of organisms uses sunlight to convert carbon dioxide and water into sugar and oxygen?

- A. carnivores
- B. decomposers
- C. herbivores
- D. producers

- 3 The law of conservation of mass can be demonstrated by a chemical reaction. Which of the following models of a chemical reaction **best** represents the law of conservation of mass?



- 4 A manufacturer wants to produce a container for food storage that does not break easily and is airtight, inexpensive, and microwave-safe. Which of the following is the **best** material to use to make the container?

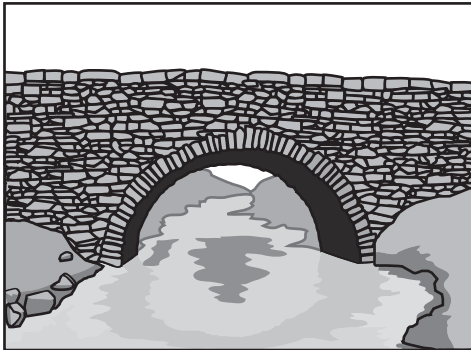
A. glass  
B. metal  
C. paper  
D. plastic

- 5 Heat from deep in Earth's interior is transferred to its crust by which of the following?

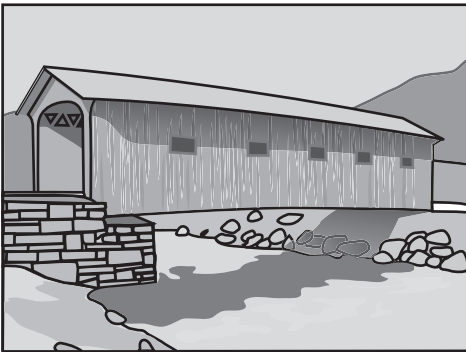
A. conduction in the ocean  
B. convection in the mantle  
C. radiation from the solid core  
D. evaporation at mid-ocean ridges

- 6 Which of the following bridges is an example of a suspension bridge?

A.



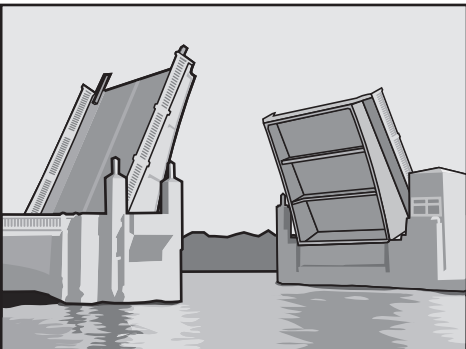
B.



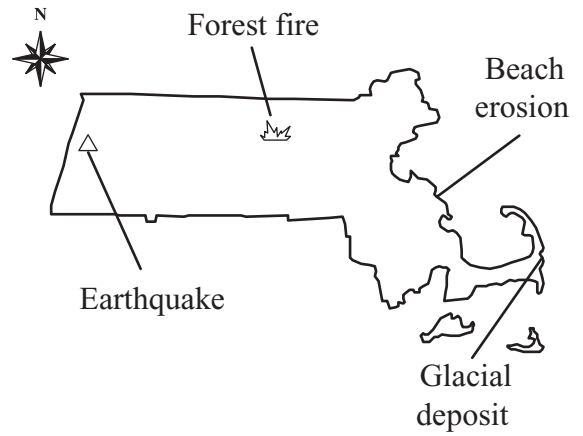
C.



D.



- 7 The map of Massachusetts below shows where physical evidence of changes can be found.



Which of these is the **best** indication that Massachusetts' climate has changed over time?

- A. earthquake  
B. forest fire  
C. beach erosion  
D. glacial deposit
- 8 Which of the following is the **primary** advantage of sexual reproduction when compared to asexual reproduction?
- A. There is a greater number of offspring.  
B. There is more food available to offspring.  
C. There is greater genetic variety in offspring.  
D. There is a longer development time for offspring.

- 9 The ocean water near the equator absorbs more heat throughout the year than ocean water near the North Pole. Which of the following **best** explains this difference?
- A. The equator is closer to the Sun.
  - B. The equator has higher sea levels.
  - C. The equator receives more direct sunlight.
  - D. The equator rotates more quickly on Earth's axis.
- 10 Which of the following is an example of a physical change but **not** a chemical change?
- A. A log gives off heat and light as it burns.
  - B. A tree stores energy from the Sun in its fruit.
  - C. A penny lost in the grass slowly changes color.
  - D. A water pipe freezes and cracks on a cold night.
- 11 Which of the following Earth layers has the **greatest** density?
- A. crust
  - B. mantle
  - C. inner core
  - D. outer core

- 12 Which of the following is an example of the formation of a mixture?
- A. rust forming on an iron nail
  - B. sugar crystals dissolving in water
  - C. sodium and chlorine forming table salt
  - D. hydrogen and oxygen reacting to produce water
- 13 Which of the following identifies the **primary** function of a radio station tower in a communication system?
- A. decoder
  - B. encoder
  - C. receiver
  - D. transmitter
- 14 Laura adds 50 mL of boiling water to 100 mL of ice water. If the 150 mL of water is then put into a freezer, at what temperature will the water freeze?
- A. 0°C
  - B. 15°C
  - C. 37°C
  - D. 50°C

15 Which of the following substances can be separated into several elements?

- A. nitrogen
- B. zinc
- C. air
- D. aluminum

16 Scientists working for a company are testing a new medicine that they think will help heal damaged tissue. In which part of the company are the scientists working?

- A. distribution
- B. mass marketing
- C. public relations
- D. research

17 Which of the following statements **best** explains why earthquakes occur more frequently in California than in Massachusetts?

- A. The rock found in California is igneous, but the rock found in Massachusetts is sedimentary.
- B. California is located on the boundary of two crustal plates, but Massachusetts is not.
- C. The rock under California is soft, but the rock under Massachusetts is hard.
- D. California is located on a continental plate, but Massachusetts is not.



Questions 18 and 19 are open-response questions.

- **BE SURE TO ANSWER AND LABEL ALL PARTS OF EACH QUESTION.**
- **Show all your work (diagrams, tables, or computations) in your Student Answer Booklet.**
- **If you do the work in your head, explain in writing how you did the work.**

Write your answer to question 18 in the space provided in your Student Answer Booklet.

- 18** The table and descriptions below show some of the characteristics of the planets in our solar system.

**Planetary Data\***

Planet	Mass ( $10^{24}$ kg)	Diameter (km)	Density ( $\text{kg/m}^3$ )	Length of Day <sup>1</sup> (hours)	Distance from Sun ( $10^6$ km)	Orbital Period <sup>2</sup> (days)	Orbital Velocity <sup>3</sup> (km/s)
Mercury	0.330	4879	5427	4222.6	57.9	88.0	47.9
Venus	4.87	12,104	5243	2802.0	108.2	224.7	35.0
Earth	5.97	12,756	5515	24.0	149.6	365.2	29.8
Mars	0.642	6794	3933	24.7	227.9	687.0	24.1
Jupiter	1899	142,984	1326	9.9	778.6	4331	13.1
Saturn	568	120,536	687	10.7	1433.5	10,747	9.7
Uranus	86.8	51,118	1270	17.2	2872.5	30,589	6.8
Neptune	102	49,528	1638	16.1	4495.1	59,800	5.4
Pluto (dwarf)	0.0125	2390	1750	153.3	5870.0	90,588	4.7

\* Numerical data based on NASA information.

<sup>1</sup>**Length of Day (hours)** – This is the average time in hours that it takes for the Sun to move from the noon position in the sky at a point on the equator back to the same position.

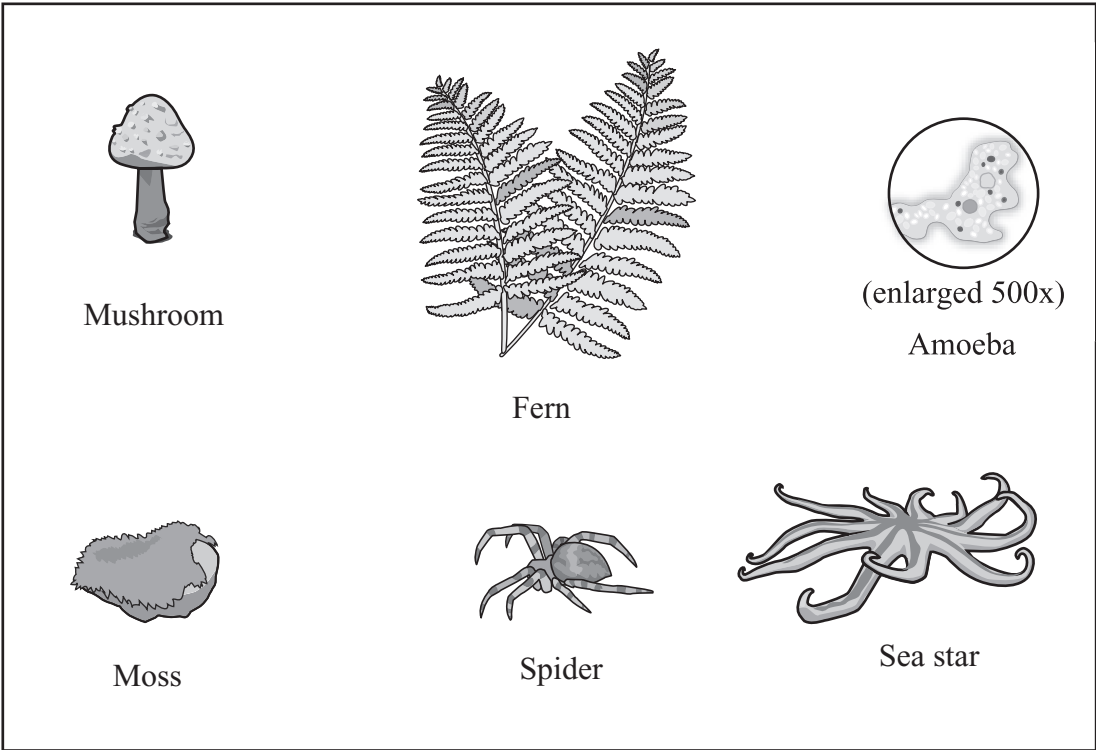
<sup>2</sup>**Orbital Period (days)** – This is the time in Earth days that it takes for the planet to orbit the Sun.

<sup>3</sup>**Orbital Velocity (km/s)** – This is the average velocity, or speed, of the planet in kilometers per second as it orbits the Sun.

- Identify the planet that has the greatest density. Include data from the table to support your answer.
- Describe the relationship between a planet's distance from the Sun and its orbital period. Include data from the table for at least **two** planets to support your answer.
- Identify the planet that rotates the fastest on its axis. Include data from the table to support your answer.

Write your answer to question 19 in the space provided in your Student Answer Booklet.

- 19 Individual organisms can be sorted into different kingdoms based on their characteristics. Pictures of six organisms and a table listing four kingdoms are shown below.



Four Kingdoms of Living Organisms

Animalia	Plantae	Fungi	Protista
SAMPLE ONLY			

- a. Copy the table above into your Student Answer Booklet.
- b. Write the name of each pictured organism under the correct kingdom in your copy of the table.
- c. For each kingdom listed in the table, describe one characteristic that all organisms in that kingdom have in common.

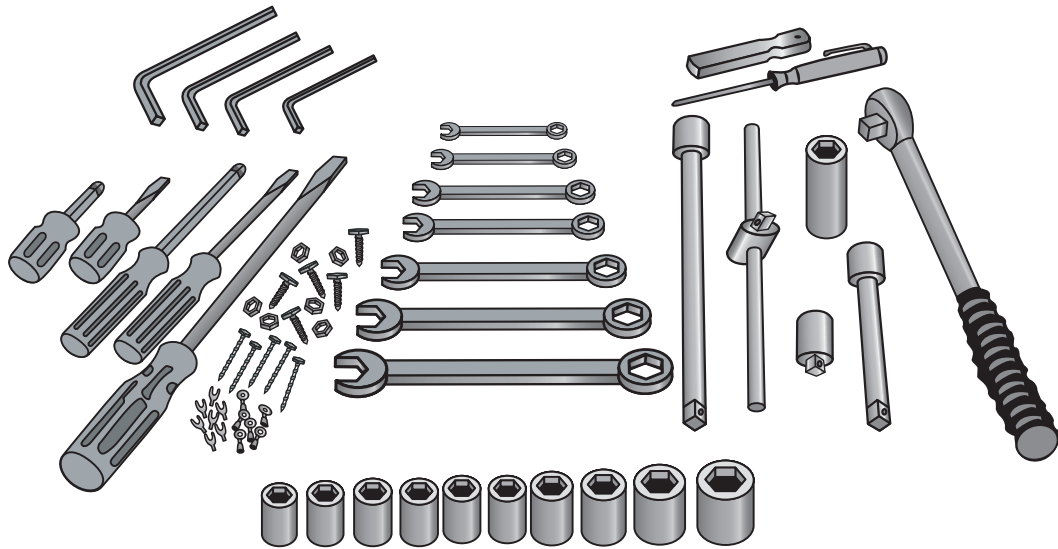
# Science and Technology/Engineering

## SESSION 2

### DIRECTIONS

This session contains seventeen multiple-choice questions and three open-response questions. Mark your answers to these questions in the spaces provided in your Student Answer Booklet.

- 20 The tools shown in the picture below are used in a factory.



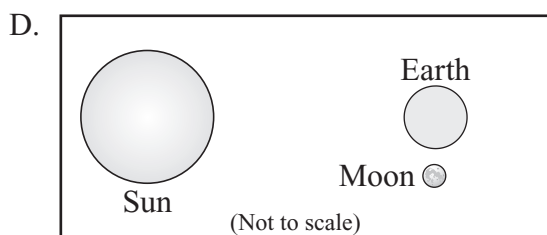
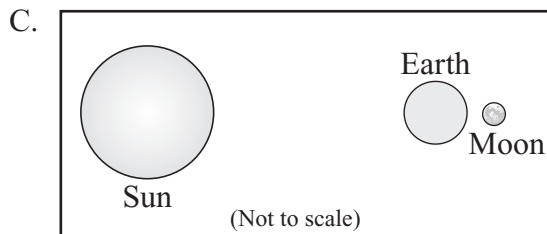
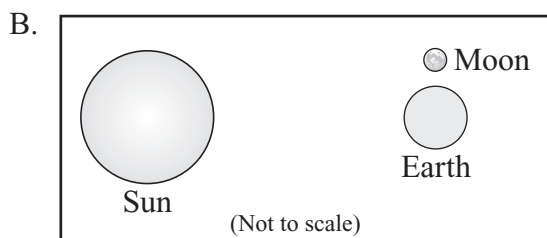
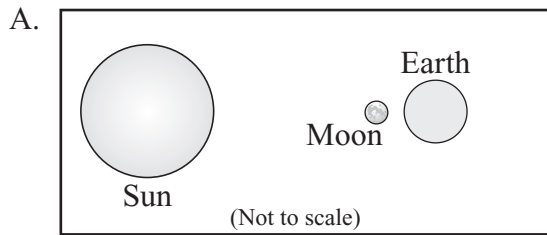
In which of the following manufacturing processes are these tools **most likely** used?

- A. assembling
- B. cutting
- C. finishing
- D. shaping

- 21 Which of the following lists is in order from **smallest** to **largest**?
- A. universe → solar system → galaxy
  - B. galaxy → solar system → universe
  - C. solar system → universe → galaxy
  - D. solar system → galaxy → universe
- 22 An escalator at a shopping mall is 10 m long and moves at a constant speed of 0.5 m/s. If José steps onto the escalator at the bottom while it is moving, how long will it take him to travel the 10 m?
- A. 5 s
  - B. 10 s
  - C. 15 s
  - D. 20 s
- 23 Which of the following areas is **most likely** to form metamorphic rocks such as gneiss and schist?
- A. a sea floor
  - B. a windblown desert
  - C. a site deep underground
  - D. a site covered by a glacier

- 24 Several interchangeable parts are used in the manufacture of automobiles. Some examples of these parts are batteries, windshield wiper blades, spark plugs, and tires.
- Which of the following is an advantage of interchangeable parts over non-interchangeable parts on automobiles?
- A. Interchangeable parts are generally more expensive than custom-made parts for automobiles.
  - B. Interchangeable parts break more often now than in years past on most automobiles.
  - C. Interchangeable parts are plentiful for custom-made automobiles.
  - D. Interchangeable parts can fit many kinds of automobiles.

- 25 Which of the following diagrams **best** shows the relative positions of Earth, the Moon, and the Sun during a lunar eclipse?



- 26 Which of the following **best** describes the number of chromosomes in a normal human liver cell?

- A. 23 pairs of chromosomes
- B. 46 different types of chromosomes
- C. 46 male chromosomes and 46 female chromosomes
- D. 23 original chromosomes and 23 duplicate chromosomes

- 27 Which of the following **best** describes a role of mushrooms in ecosystems?

- A. capturing energy from sunlight
- B. consuming living plant material
- C. taking energy from animal hosts
- D. breaking down dead plant material

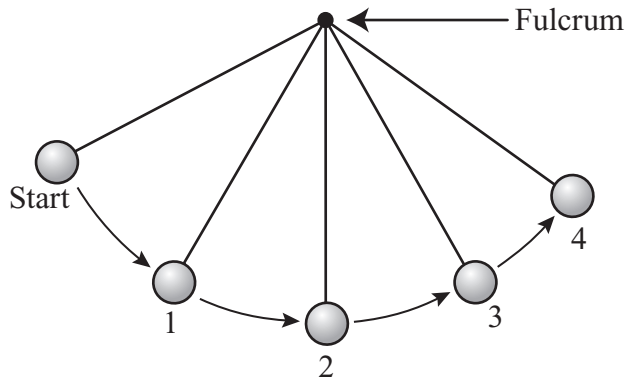
- 28 Which of the following tools is **most** useful for tightening a small mechanical fastener?

- A. chisel
- B. pliers
- C. sander
- D. saw

- 29 Which of the following is a characteristic of **all** chemical changes?
- A. A different state of matter is produced.
  - B. Some mass is converted to energy.
  - C. Some form of light is given off.
  - D. A new material is formed.
- 30 In the human body, which system functions **primarily** to defend the body against disease?
- A. digestive
  - B. immune
  - C. nervous
  - D. respiratory
- 31 What is the smallest unit of an element that still has the properties of that element?
- A. an atom
  - B. a compound
  - C. an electron
  - D. a molecule

- 32 Lichens are symbiotic organisms made of green algae and fungi. What do the green algae supply to the fungi in this symbiotic relationship?
- A. carbon dioxide
  - B. food
  - C. protection
  - D. water
- 33 Which of the following **best** describes an advantage of using a mass production manufacturing system instead of a custom manufacturing system?
- A. Customers can provide specific feedback to workers.
  - B. Workers become skilled in all aspects of assembly.
  - C. Goods can be easily modified for customers.
  - D. Products can be made at a lower cost.

- 34 The diagram below shows some positions in the path of a pendulum swinging from a fixed point called a fulcrum.



The pendulum is raised to the start position and released. At which two numbered positions is the potential energy of the pendulum **most likely** the same?

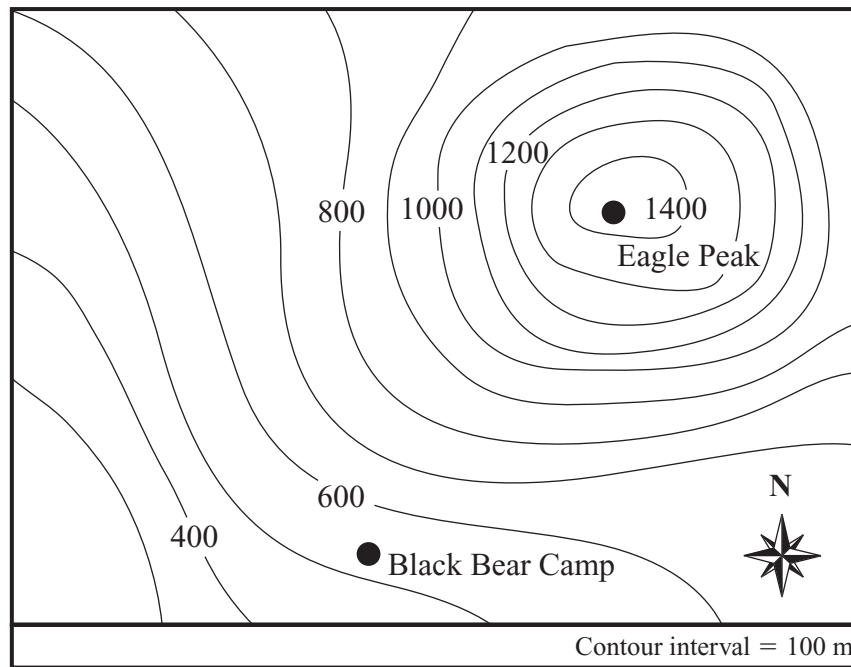
- A. position 1 and position 3
- B. position 1 and position 4
- C. position 2 and position 3
- D. position 2 and position 4

- 35 Which of the following describes a reason why companies irradiate some fruits and vegetables before they are sold to the public?

- A. to improve the flavors by increasing the sugar content
- B. to speed up the ripening of produce picked too early
- C. to partially cook the produce before canning or freezing
- D. to extend the shelf life by killing existing microorganisms



- 36 A map with contour lines is shown below.



Which of the following is the **best** estimate of the difference in elevation between Black Bear Camp and Eagle Peak?

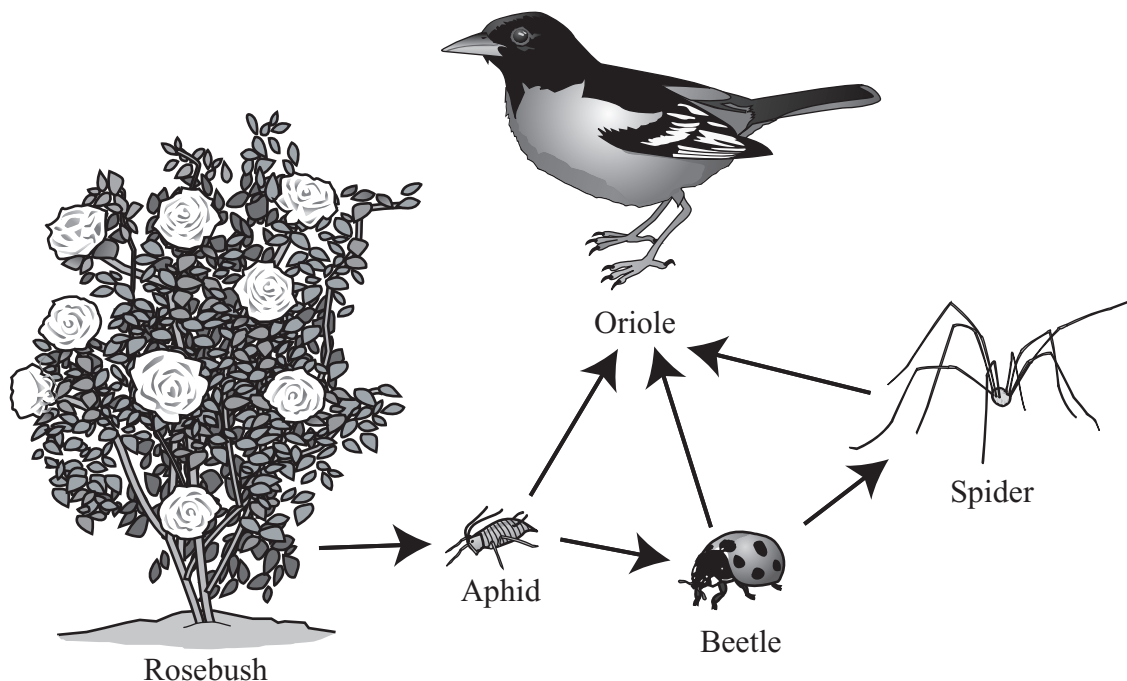
- A. 400 m
- B. 900 m
- C. 1200 m
- D. 1500 m

Questions 37 through 39 are open-response questions.

- **BE SURE TO ANSWER AND LABEL ALL PARTS OF EACH QUESTION.**
- **Show all your work (diagrams, tables, or computations) in your Student Answer Booklet.**
- **If you do the work in your head, explain in writing how you did the work.**

Write your answer to question 37 in the space provided in your Student Answer Booklet.

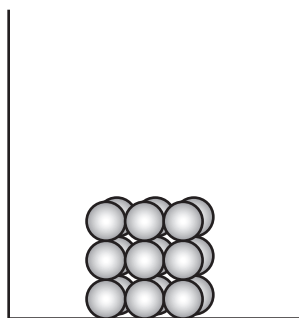
- 37 The organisms in an ecosystem interact in many ways to survive. For example, a rosebush, aphids, beetles, spiders, and orioles all interact in a rosebush ecosystem. The diagram below shows how these organisms interact in a partial food web.



- Identify the producer organism in this food web. Explain the reasoning for your answer.
- Identify the primary consumer organism in this food web. Explain the reasoning for your answer.
- Describe what would **most likely** happen to each of the other organisms in the food web if the beetle population were suddenly destroyed. Explain the reasoning for your answer for each organism.

Write your answer to question 38 in the space provided in your Student Answer Booklet.

- 38** The diagram below shows a model in an open container. The model represents the arrangement of particles of matter in a solid phase.

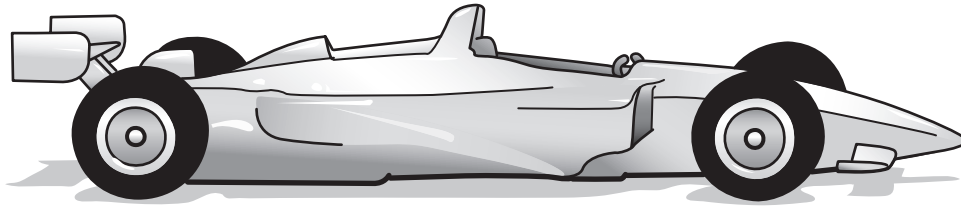


Solid

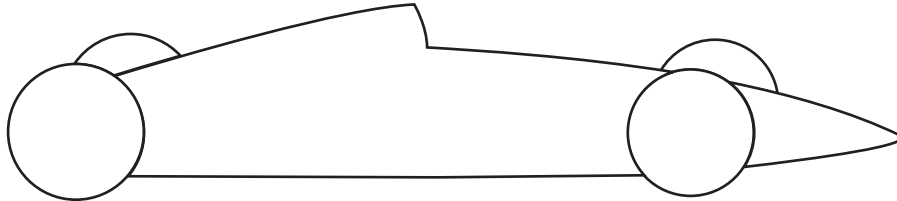
- Draw a diagram showing the arrangement of these particles in a liquid phase. Explain why the particles have this arrangement. Be sure to describe the energy of the particles.
- Draw a diagram showing the arrangement of these particles in a gas phase. Explain why the particles have this arrangement. Be sure to describe the energy of the particles.

Write your answer to question 39 in the space provided in your Student Answer Booklet.

- 39 The diagram below shows a Formula 1 racing car. Many forces act together on the racing car so it can move safely at high speeds on a racetrack.



- a. Copy the simple diagram of a racing car shown below into your Student Answer Booklet.



- b. Using your copy of the diagram, draw arrows to show how the forces of thrust, drag, and gravity act on the racing car as it moves forward on a racetrack. Label each arrow as thrust, drag, or gravity.
- c. Describe how **each** force that you labeled in part (b) acts on the racing car as it moves on a racetrack.

**Grade 8 Science and Technology/Engineering**  
**Spring 2007 Released Items:**  
**Reporting Categories, Standards, and Correct Answers**

Item No.	Page No.	Reporting Category	Standard	Correct Answer (MC)*
1	437	<i>Earth and Space Science</i>	8	B
2	437	<i>Life Science (Biology)</i>	16	D
3	438	<i>Physical Sciences (Chemistry and Physics)</i>	4	A
4	438	<i>Technology/Engineering</i>	1.1	D
5	438	<i>Earth and Space Science</i>	3	B
6	439	<i>Technology/Engineering</i>	5.2	C
7	439	<i>Earth and Space Science</i>	7	D
8	439	<i>Life Science (Biology)</i>	10	C
9	440	<i>Earth and Space Science</i>	4	C
10	440	<i>Physical Sciences (Chemistry and Physics)</i>	10	D
11	440	<i>Earth and Space Science</i>	2	C
12	441	<i>Physical Sciences (Chemistry and Physics)</i>	8	B
13	441	<i>Technology/Engineering</i>	3.1	D
14	441	<i>Physical Sciences (Chemistry and Physics)</i>	9	A
15	442	<i>Physical Sciences (Chemistry and Physics)</i>	8	C
16	442	<i>Technology/Engineering</i>	4.3	D
17	442	<i>Earth and Space Science</i>	5	B
18	443	<i>Earth and Space Science</i>	10	
19	444	<i>Life Science (Biology)</i>	1	
20	445	<i>Technology/Engineering</i>	4.4	A
21	446	<i>Earth and Space Science</i>	12	D
22	446	<i>Physical Sciences (Chemistry and Physics)</i>	11	D
23	446	<i>Earth and Space Science</i>	6	C
24	446	<i>Technology/Engineering</i>	4.2	D
25	447	<i>Earth and Space Science</i>	9	C
26	447	<i>Life Science (Biology)</i>	8	A
27	447	<i>Life Science (Biology)</i>	15	D
28	447	<i>Technology/Engineering</i>	1.2	B
29	448	<i>Physical Sciences (Chemistry and Physics)</i>	10	D
30	448	<i>Life Science (Biology)</i>	6	B
31	448	<i>Physical Sciences (Chemistry and Physics)</i>	6	A
32	449	<i>Life Science (Biology)</i>	13	B
33	449	<i>Technology/Engineering</i>	4.1	D
34	450	<i>Physical Sciences (Chemistry and Physics)</i>	13	A
35	450	<i>Technology/Engineering</i>	7.2	D
36	451	<i>Earth and Space Science</i>	1	B
37	452	<i>Life Science (Biology)</i>	14	
38	453	<i>Physical Sciences (Chemistry and Physics)</i>	15	
39	454	<i>Technology/Engineering</i>	6.4	

\* Answers are provided here for multiple-choice items only. Sample responses and scoring guidelines for open-response items, which are indicated by shaded cells, will be posted to the Department's Web site later this year.

